

overcoat are applicable. In an alternative embodiment, shown in Figure 5, a steel working surface 402 is used in conjunction with an aluminum substrate 404, preferably further incorporating conformal cooling channels 406 or highly conductive heat sinks such as copper or aluminum-clad graphite.

5 The reconfiguration of large components is always a challenge, since high mass makes accurate translation difficult. For relatively flat surfaces, the problem may be overcome using moving optics while keeping the tool stationary. However, if the tool requires deposition on a curved surface away from the line of sight of the laser, then moving optics (on a gantry system, for example) will not be effective. In such instances,
10 a robotic embodiment of the moving system is utilized. Using this configuration, the beam and material can be delivered in almost in any position of the object with a robot and the material delivery system mounted on its wrist. Such system will increase the flexibility of CLDMD even further to process stationary three dimensional objects and add feature at least on 270° work envelop around the object.

15 I claim:

1. A method of enhancing a mold, die, or tool, comprising the steps of:
2 providing a mold, die or tool having a body with a working surface; and
modifying the body, the working surface, or both, directly from CAD data using a
4 closed-loop, direct metal deposition process.
2. The method of claim 1, wherein at least a portion of the working surface is
2 modified to improve wear resistance.
3. The method of claim 1, wherein at least a portion of the working surface is
2 modified to improve resistance to dissolution during a die casting operation.
4. The method of claim 1, wherein at least a portion of the working surface is
2 modified to improve oxidation resistance.
5. The method of claim 1, wherein at least a portion of the body is modified
2 to incorporate cooling channels to improve thermal management.
6. The method of claim 1, wherein at least a portion of the body is modified
2 to incorporate conductive heat sinks or thermal barriers to improve thermal management.
7. The method of claim 1, wherein at least a portion of the body or working
2 surface is modified to produce a lightweight tool or component.
8. The method of claim 7, wherein at least a portion of the body contains
2 aluminum.
9. The method of claim 8, wherein at least a portion of the body is cast
2 aluminum-silicon.

10. The method of claim 8, wherein at least a portion of the working surface is
2 modified to produce a wear-resistant or high-temperature material.

11. The method of claim 10, wherein at least a portion of the working surface
2 is a metallurgically bonded molybdenum alloy.

12. The method of claim 10, further including a nickel alloy bond coat for
2 improved service life for die casting of low melting point materials such as Zn alloys.

13. The method of claim 1, further including a steel working surface.

14. The method of claim 1, wherein the closed-loop DMD process is based
2 upon a robotic implementation to process three-dimensional objects having a large mass
and/or complexity.

15. An enhancing a mold, die, or tool fabricated in accordance with the
2 method of claim 1.

16. An enhancing a mold, die, or tool fabricated in accordance with the
2 method of claim 2.

17. An enhancing a mold, die, or tool fabricated in accordance with the
2 method of claim 3.

18. An enhancing a mold, die, or tool fabricated in accordance with the
2 method of claim 4.

19. An enhancing a mold, die, or tool fabricated in accordance with the
2 method of claim 5.

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20. An enhancing a mold, die, or tool fabricated in accordance with the
2 method of claim 6.